the next three years of an income large enough to secure the aid of competent assistants in the different departments, we shall be able to put our immense collections in complete order, and to enlarge the building sufficiently to exhibit all our specimens in their true relations. I hope that in three years any intelligent observer will be able to say that a mere walk through our museum teaches him something of the geographical distribution of animals, of their history in past ages, of the laws controlling their growths as they now exist, and of their mutual affinities—in short, that the whole will be so combined as to illustrate all that science has thus far deciphered of the plan of creation. This is my hope, and it is shared by the efficient corps of assistants on whose co-operation I largely depend for its fulfilment (p. 4)." Prof. Agassiz has set himself a noble task, and we doubt not that when it is completed, the museum of Harvard College will be an intellectual monument worthy alike of its curator and of the science of which he is so distinguished an ornament.

OUTLINES OF HUMAN PHYSIOLOGY

Grundriss der Physiologie des Menschen. Von Prof. Dr. L. Hermann. Dritte gänzlich umgearbeitete Auflage. 1870. (Berlin: Hirschwald. London: Williams and Norgate.)

WHEN this work first appeared, now more than seven years ago, it at once became our favourite handbook of physiology, and it has ever since been our constant companion. Perhaps the chief reason why it so especially commended itself to us was the fact that it served as the clearest and best exponent of what may be called the radical school of physiology. Its general arrangement differed altogether from that of most modern text-books. It entirely threw on one side that division into "functions" (function of respiration, function of digestion, and the like) which, after all, does not lessen much the labour of the author, and certainly leads the student astray, throwing, as it does, into the background, or even completely hiding, the essential oneness and solidarity of the animal body, and bringing the learner to regard the organism as a bundle of "functions," one of which might easily be pulled away without much harm being done. The leading idea of the book was to follow out as closely as possible the doctrine of the conservation of energy. That idea was kept steadily in view throughout the volume, and faithfully adhered to.

Another remarkable feature was the bold attitude taken up towards recent discoveries. These are always great stumbling-blocks to teachers and text-books. Some authors, especially German authors, put in everything that comes up, leaving time and future editions to take out again the things that wither up. Others, again, put in nothing that does not seem to be already fairly established, and the student who trusts to these alone has perhaps to wait several years, till a new edition tells him of results which have had, it may be, a most powerful influence on the progress of the science for as many years back. A third class, and of these Prof. Hermann is one, make up their mind as to what they think will stand and what will not, and so accept the one and reject the other, though both may have been published yesterday. This course being bold is of necessity dangerous; and a new edition is, in the case of such books, a most critical occasion.

An unusual popularity has now brought the present work to a third edition, and the author may certainly congratulate himself on the little which he has had to undo Many new things which in 1863 he boldly accepted have since been ratified by general consent.

The present edition differs from the preceding two in being made much larger and more complete. We trust that it has now reached its full growth, for one of the great merits of the first edition was its small size. Otherwise, beyond the increased filling up of all parts, the book does not differ materially from what it was. We are glad to see that several oversights, such, for instance, as the extraordinary statement of the first edition that the apex of the heart beats between the seventh and eighth ribs, have been corrected, and that the author gives a fair account of matters in reference to which he has been engaged in personal controversies, as, for example, in the physiology of muscle.

The boldness in selection of material to which we have referred, renders the book in some measure unsuitable for a student not sufficiently advanced to have acquired a physiological judgment; but we would urge it upon the notice of all who wish to have a clear and succinct exposition of the physiology of the present day.

M. F.

OUR BOOK SHELF

On the Strength of Beams, Columns, and Arches. By B. Baker, Assoc. Inst. C.E. (London: E. and F. N. Spon, 1870.)

THE subject matter of this little volume is of great importance to Civil Engineers. All structures resolve themselves ultimately into beams, columns, and arches, of some kind. It is therefore of great importance that the engineer should be familiar with the mode of ascertaining their strength or their resistance. We approve, in the main, of Mr. Baker's endeavour to dispense with high mathematics by substituting geometrical solutions for ordinary problems, because, unfortunately, mathematics is not the strong side of English engineers, although England has produced the greatest of mathematicians. But the author seems to labour under serious misapprehensions. He proposes his geometrical solutions, because he thinks that the use of mathematics "involves an unjustifiable waste of time, with the great contingent disadvantage that it checks the growth of sound judgment in the engineer, by giving a fictitious appearance of accuracy to his results which are not susceptible of exact deduction." This is a grievous error. The spirit of mathematics is the expression of most acute and refined reasoning; and how can the practice of intellectual reasoning check the growth of sound judgment in the engineer? The fictitious appearance of accuracy above mentioned, is altogether beside the question, because it is optional; but not so the correctness of our reasoning and arguments. The author makes the above statement in his preface, and we find, unfortunately, that throughout the volume the spirit of mathematics is sadly offended. Let us take for example the author's mode of calculating the strength of beams. He shows us how the strength of a beam may be found geometrically, and derives the formulæ for rectangular and other beams, assuming the neutral axis of the beam to pass through the centre of gravity of the sectional area of the beam.

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He then proceeds to compare the calculated resistance of certain simple beams with the observed resistance as ascertained by experiment, and he finds that there is a large discrepancy between the calculated and the experimental ultimate resistances. Adopting Mr. Barlow's notation, he calls f the ultimate resistance to direct tension, F the "apparent" resistance to the same force excited by transverse strain, and ϕ the "resistance due to flexure," then $F = f + \phi$. This will be better understood by reference to figures. Mr. Hodgkinson found in the experiment under consideration, that a square inch of cast iron was ruptured under direct tension by 18,750lb., which in the above equation would be the value of f. When, however, a rectangular bar of the *same* material, one inch square, was tested, a weight of 527lb. applied at the centre of a span of sixty inches, just broke the bar. Applying now the formulæ for rectangular beams to this result, the author finds that the ultimate tensile strength of the sample under consideration must be assumed at 45,630lb. in order that the bar may be able to offer the resistance shown in the experiment; the figure 45,630 he calls the "apparent" tensile strength, and would be the value of F in the above equation; accordingly, $45{,}630 = 18{,}750 + \phi$, or $\phi = 26{,}880$lb., this value of ϕ being termed "resistance due to flexure," a term, we are informed, invented by Mr. W. H. Barlow;[*] and this new resistance being described as "lateral adhesion of the fibres;" and the author informs us, that the neglect of it may result in an error up to 190 per cent.

We have here a fine confusion of everything referring to the subject. An error is made, which to explain away, a new one must be committed; forces hitherto not suspected by mathematicians are discovered by those whose sound judgment was not checked in its growth by the infinitesimal calculus.

Does the author not know the condition which determines the position of the neutral axis of a beam? The neutral axis passes through the centre of gravity of the sectional area of a beam, provided *the resistance of the material to tension and to compression be alike*. In almost every material these resistances differ from one another, but when only a small fraction of the ultimate resistance of the material need be taken into account—say one fourth—then for practical purposes they may be assumed to be alike.

The author proceeds, however, to breaking strain, using cast iron; its ultimate resistance to tension is about eight tons per square inch, to compression about forty tons. Under these circumstances his original formula no longer holds good; the neutral axis no longer passes through the centre of gravity of the section of the beam, it approaches more and more the side where the greater resistance is offered; and were the resistance to compression infinitely great, the neutral axis would coincide with the position of the extreme fibre of the beam on the compression side, and the whole sectional area would be resisting tension only, and the extreme fibre balanced by compression. The beam would then have just double the resistance without assuming the least increase of tensional resistance of the material. The author's ϕ expresses, therefore, the amount of error into which he and others have fallen, and in case it should be zero, they will find $F = f$ as it should be, and the elaborate fabric of confusion disappears.

In other respects, the work contains much valuable information, and if the unfortunate mistake above referred to, did not crop up throughout the 300 pages, and a natural flow of clear language were substituted for a rather dogmatic and vague style, we should be glad to recommend it to the profession, which ought to have all the aid that modern science can afford. * * * * *

Meteorology. By Sir John F. W. Herschel, Bart. From the Encyclopædia Britannica. Second Edition. (Edinburgh: A. & C. Black.)

Introductory Text-book of Physical Geography. By D. Page. Fourth Edition. (Edinburgh: W. Blackwood & Sons.)

We class these two books together as new editions of standard treatises in their respective departments of science that are among the best that can be used by students or teachers. The term "Meteorology," which has entirely lost its etymological meaning, is defined by Sir John Herschel as "the description and explanation of those phenomena which group themselves under the head of the weather, of the seasons, and of the climate," a branch of natural science of the laws regulating which we are at present almost entirely ignorant, as Dr. Balfour Stewart has shown in these pages. Writers on physical geography content themselves at present with a description of the physical contour of the globe, with some slight reference to its climatology, and the distribution of its animal and vegetable life, Mrs. Somerville's handbook being, as far as we know, the most complete in this respect. The better and more logical mode would seem to us to be, first of all to treat of the earth as a member of the solar system, and thence to deduce the laws which govern its natural phenomena; we believe that in this way such phenomena as those of ocean currents and trade winds, and the variations of climate, would be rendered far more quickly intelligible to the learner than is now the case. From his stand-point, Dr. Page's "Introductory Text-book" discusses the subject in his usual clear, concise, and systematic manner.

Rustic Adornments for Homes of Taste. By Shirley Hibberd. New Edition. (London: Groombridge & Sons.)

That two editions of this book have been disposed of in a short time is ample justification for the publication of a third, especially when got up in so handsome a style as the one before us. Works of this kind appeal to a large public, not over-critical as to scientific accuracy, but glad to possess that amount of knowledge which enables them to talk about ferneries and aquaria without committing any egregious blunder. We are far from depreciating the value of this smattering of science where it is all that opportunity permits to be attained. Those who like their homes to be surrounded by beautiful natural objects will here find a large fund of information respecting the aquarium, the fernery, the aviary, the apiary, the conservatory, &c., given in a pleasant style, illustrated with woodcuts and coloured plates. The volume makes altogether a very pretty gift-book, especially for a young lady.

E. Millon, sa Vie, ses Travaux de Chimie, et ses Etudes économiques et agricoles sur l'Algérie. Pp. 327. (London: Williams and Norgate, 1870.)

M. Reiset, in the preface, tells us that after the death of Millon, his friends and pupils undertook the publication of a collection of abstracts of the numerous works of this illustrious chemist. The book commences with an interesting biographical notice of Millon, by Dr. Hœfer, in which the political questions which led to his long residence in Algeria are as slightly noticed as possible. The principal portion of the volume was arranged by M. Jules Lefort, with the assistance of MM. Coulier, Commaille, and the late Professor Nicklès. The book contains two hitherto unpublished papers, each extending over forty-three pages, one "on Fermentation" and the other "on the Economic and Agricultural problem of Algeria." The researches on corn also occupy considerable space. The other investigations of Millon are arranged in a very interesting manner, frequently in connected treatises. Opposite the title-page is a good photograph of a bust by M. Clément, and at the end of the book is a chronological list of the scientific works of the author, amounting in number to no less than seventy-nine.

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[*] Mr. Barlow, F.R.S., recently read a paper before the Royal Society on this subject, reviving his theory on the resistance of beams to transverse strain.

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